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Clues to Columbine Evolution in *Aquilegia laramiensis* (Laramie columbine)

By Marion Chartier, PhD [1]

Aquilegia laramiensis (Laramie columbine) is endemic to the Laramie Mountains in Wyoming. It is found on the Medicine Bow National Forest and Bureau of Land Management lands. It has been surveyed on public lands and its fire response has also been studied. Yet little is known about its life history and its pollinators in particular.

Laramie columbine is the only North American species with almost completely white flowers and short nectary spurs. Its delicate white flowers are very similar in shape to their bee-pollinated Asian and European columbine relatives that usually produce purple/blue to white flowers oriented downwards and with rather short spurs. In North America, three other *Aquilegia* species with blue or white flowers share these characteristics: *Aquilegia jonesii* (Jones' columbine), *A. saximontana* (Rocky Mountain blue columbine), and *A. brevistyla* (smallflower columbine). The rest of North American species are pollinated by hummingbirds and hawkmoths in addition to bees.

Columbines have been used as a model for studying the evolution of the flower and in particular to understand the genetic bases of floral development. The genus is also highly interesting, since it is believed that the different types of flowers it contains evolved morphologically under selection for different types of pollinators. The current hypothesis is that the ancestor of the genus was similar to some of the current European and Asian species (as well as the four above-mentioned American ones), in bearing flowers with rather short spurs thus possibly associated with fly, bee or bumble bee pollination. In North America, where columbine presumably arrived later, two additional morphs appeared: red flowers with medium-sized spurs, mainly pollinated by hummingbirds, and then pale flowers with the longest spurs, mainly pollinated by hawkmoths. Only a fourth of all c. 100 known columbine species have been studied for pollination yet. (Cont. p. 7)

Above: Laramie columbine (*Aquilegia laramiensis*), photo by Michael Münch.

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WYNPS News

New Members: Please welcome the following new members to WYNPS: Kerry Gold, Pinedale; Barb Gorges, Cheyenne; Dulcinea Groff, Laramie; Emerald Gustowt, Jackson; Jackie Hauptman, Laramie; Kenneth Loveland, Provo UT; Ann Lurie, Jackson; Debi Morley, Pinedale; Dale Naylor, Wilson; Emily Paasche, Teton Village; Susan Patla, Tetonia, ID; Jennifer Poore, Salt Lake City, UT; Stephanie Quick, Casper; Brian Stanford, Lander; Elizabeth Thompson, Jericho VT; Katie Wilson, Gillette.

2022 Annual Meeting – Hot Springs County at last!

The Society is pleased to announce that next year's meeting will he held - for the first time ever - in Thermopolis. If you are a member local to that area and have ideas to share or would like to lead a hike, please get in touch. EF

Treasurer's Report: Balance as of Sept 17: Scholarship = $1254; General = $264.74; Total = $9518.74.

WYNPS Board – 2021

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Teton Plants: Amy Taylor, Treasurer; (tetonplants@gmail.com). Check the chapter homepage (https://tetonplants.org/) for upcoming events.

Next issue: Please send articles and announcements by 15 November to the address below (ATTN editor):

Wyoming Native Plant Society
P.O. Box 2449
Laramie, WY 82073

Message from the President

Fall Greetings!

A huge thank you to everyone who made the 2021 Annual Meeting in June so special. Friday afternoon opened with a reception and tours of the Rocky Mountain Herbarium at the University of Wyoming by Dr. Greg Brown, Ernie Nelson, and Larry Schmidt. Later on we spent a lovely, rainy couple of hours botanizing the spectacular wildflower displays around the group campsite in the Laramie Range. Saturday, Ernie led a hike at Libby Flats in the Snowy Range, and we botanized the alpine tundra, complete with late June snow squalls and charismatic microflora. Bonnie Heidel and Dorothy Tuthill took a dedicated group to Friend Park to check out endemic Laramie columbine and came across all kinds of stunning wildflower displays along the way. Saturday evening, we celebrated the 40th anniversary of the Society, and Charmaine Delmatier presented the Hartman Award to Jennifer Whipple *in absentia*, paying tribute to Jennifer's dedicated botany career while interweaving stories of their long friendship. We were also treated to a talk by Dr. Brent Ewers about the way plants within various ecosystems adapt to our harsh climate, and the implications of aridification on plant physiology at a molecular level. On Sunday, Bonnie led a trip to Red Buttes, a research site near Laramie with a diverse wetland flora, while Joy Handley guided us in both the botany and recent cultural history of the MacGuire Ranch. The weekend closed out Sunday afternoon with Greg Pappas leading us on a rainy romp through a fen at Pole Mountain, where we saw rare willows and a bladderwort. Willow expert Dr. Bob Dorn joined us on this hike - I'll never forget him patiently pointing out features of *Salix boothii*, commenting at the end that it was a species he described!

Emma Freeland

Contributors to this Issue: Marion Chartier, Eva Crane, Charmaine Delmatier, Robert Dorn, Katy Duffy, Emma Freeland, Bonnie Heidel, Ben Legler, Dorothy Tuthill.

Call for Nominations: Are YOU interested in joining the Wyoming Native Plant Society Board? Nominations and volunteers are invited – please contact wynps@wynps.org or contact the Secretary/Treasurer. The deadline is 15 November.

2021 Annual Meeting

Right: Abundant *Hymenoxys grandiflorus* greeted tourgoers in the Snowy Range, photo by Emma Freeland.

Above: Dr. Greg Brown, Acting Director, spoke at the Reception and Tour of the Rocky Mountain Herbarium, photo by Bonnie Heidel.

Above: Charmaine Delmatier, B. E. "Ernie" Nelson and Dr. Dorothy Tuthill (left to right). The 2021 gathering brought together founding and first-time members, from near and far, photo by Charmaine Delmatier.

Above: Medicine-Bow National Forest was base camp for the 2021 annual meeting, and destination for a romp among rare willows and bladderwort, photo by Bonnie Heidel.

Above: Ernie Nelson led the Libby Flats hike, where plant colors took on radiance amid low clouds and high spirits, photo by Eva Crane.

Above: Asuka Nobayashi at Friend Park
Left: Dr. Brent Ewers at Friend Park, photos by Bonnie Heidel.

A Trip down Memory Lane

WYNPS Milestones

By Katy Duffy[2]

...It all started when I noticed that Denise Culver was wearing a Wyoming Native Plant Society t-shirt. It was the late '80s and we were all dancing to a favorite Jackson Hole band at Diana Osuna and Tom Stallings' wedding reception at Signal Mountain Lodge in Grand Teton. I was pleased to learn that Wyoming had a native plant society, but remember how difficult it was to get information in pre-Google days. So I pestered Denise to stop dancing and tell me all about the organization and how I could join. And I joined immediately, as I recall.

In the summer of 1991, Hollis Marriott and another botanist came to see me while I was working in Grand Teton National Park. I had met Hollis when she was doing botanical studies in Grand Teton. Hollis knew I loved wildflowers so she asked me if I would be willing to start a chapter of the WYNPS. I agreed and enlisted help from Diana Osuna, another Teton County native plant enthusiast. Joan Lucas, a friend from the Jackson Hole Bird Club who also knows and loves native plants, volunteered to take care of fees and donations.

We were off and running, with well-attended monthly meetings of the Teton Chapter advertised by word of mouth and notices in the Jackson newspapers. Within a short time, I became the unofficial coordinator of this new chapter. Diane Carillo kindly helped me to mail out meeting announcements. Susan Marsh shared her considerable botanical knowledge by frequently leading field trips. Dick Shaw, retired Utah State University botanist and former seasonal Grand Teton ranger-naturalist, delighted at the formation of a chapter of the WYNPS, gave a few presentations to packed audiences during the chapter's first few years. During the second half of the '90s, Stuart Markow led field trips and gave informative presentations at several of our monthly meetings. My favorite were Stuart's workshops on native and non-native grasses. Stuart would gather enough of each grass species so that every participant could take a stem and write the common and scientific name on the string labels that Stuart provided. I learned by reviewing those specimens and saved them for years. Frank and John Craighead graciously led a field trip, using the Peterson wildflower guide they authored as a reference. We could always count on help from WY NPS officers and board whenever we asked.

Above: Jennifer Whipple, WYNPS President in 2002, in a classic demonstration of the botanist's crawl at the sight of Shoshonea (*Shoshonea pulvinata*) on Heart Mountain, photographed at the 2002 Annual Meeting. Photo by Bonnie Heidel

The new Teton Chapter even hosted an annual meeting of the WYNPS, a very simple affair. I recall that we had no place to hold the business meeting so we all sat on the curb of the parking lot near the Colter Bay amphitheater. One field trip at this annual meeting went to Two Ocean Lake. That was my introduction to shuffling and crawling along as the professional botanists in attendance mulled over identification of nearly every plant we encountered. But what a joy it was to be in the company of botanists and other plant enthusiasts, and what a magnificent learning opportunity it is, one that I will always cherish!

(Editor's Note: The Teton Chapter, now called Teton Plants, was the first chapter to form in WYNPS. *Do you have a favorite memory of WYNPS events? How did you first hear about WYNPS? In this, our 40th anniversary year, we get to be nostalgic!*)

[2] Katy Duffy is Past-President of WYNPS, retired Chief of Interpretive Services in Yellowstone National Park and one of those special people behind the founding and flourishing of the Teton Chapter of WYNPS.

Addition to the State Flora

New non-native nettle (*Urtica urens*) in Wyoming

By Ben Legler

Above: Dwarf nettle (*Urtica urens*), whole plant, on University of Wyoming campus. Photo by Ben Legler

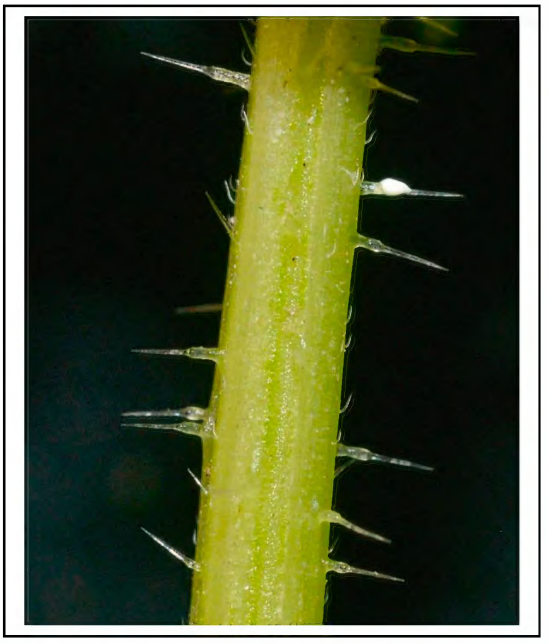
I am constantly on the lookout for unusual or overlooked weeds, and moving to a new area inevitably leads to the happenstance discovery of new weeds while exploring local neighborhoods. Such was the case this past August when I arrived in Laramie to take the role of Digital Curator in the Rocky Mountain Herbarium at the University of Wyoming. During my first week on campus, while walking past the flower beds near the Aven Nelson Building where the Herbarium is housed, I was intrigued by a dense patch of small nettles growing under several spruce trees. A closer look revealed the plants to be *Urtica urens* (dwarf nettle or burning nettle), which I soon learned was not previously documented from Wyoming. Here was a new weed for Wyoming growing a literally a stone's throw from the largest herbarium in the region! Although surprising, it's a pattern I've come to expect.

Urtica urens is an annual herb native to Eurasia that is now widely introduced throughout much of the world, though not previously known in the Rocky Mountain region. In some parts of the world, it is a serious pest of agricultural fields. Although smaller than *Urtica dioica* (our native stinging nettle), *Urtica urens* packs just as much of a bite. The plants are amply armed with hollow, stinging hairs that act like minute hypodermic needles. When touched, the brittle, needle-like tip breaks off and the jagged, open end of the hair penetrates the skin and injects a mix of irritants including histamine, acetylcholine, and formic acid. Adding to the species' punch is its fecundity—a single plant can reach maturity in as little as 5 weeks and produce over 1,000 seeds, with the seeds reportedly remaining viable in the soil for several decades. It appears our localized campus introduction may be here to stay!

How did this nettle reach Wyoming? One clue was the smell of ammonia in the air around the plants. I did not expect such an odor from the plants themselves (the name *urens*, by the way, means "burning," presumably in reference to the plant's sting, not a "urine" odor). I soon realized that the cluster of spruce trees under which this nettle patch was growing hosted a communal turkey vulture roost and the ground was littered with their droppings containing uric acid. Circumstantially, it appears *Urtica urens* recently hitched a ride to Wyoming as seeds on the feet (or in the excrement?) of vultures following their migratory routes north from Mexico and Central America and found fertile ground in the foul-smelling, nitrogen-enriched soil beneath their roost. Exploration of other areas on campus revealed only one, much smaller patch of nettles under an adjacent clump of trees, further suggesting the plants first established under the vulture roost.

But in fairness to the vultures, let's consider another likely explanation—that the nettle arrived as seeds in landscaping materials such as mulch, topsoil, or plant containers. This is a common means by which weeds can spread to new areas. If so, our new nettle would join several other very uncommon (for Wyoming) garden weeds found in flower beds on campus that may have arrived in this manner, including *Euphorbia peplus, Galinsoga quadriradiata, Oxalis corniculata, Spergularia media*, and *Veronica persica*. Unfortunately for the vultures, I saw no evidence of recent landscaping activity under those spruce trees, and no ornamentals are planted there, so this establishment mechanism seems less likely for the nettle.

As demonstrated by dwarf nettle, Wyoming's exotic weed flora is dynamic and will continue to grow as new species are inadvertently or intentionally brought in through human activity or arrive through natural dispersal mechanisms. Developed areas, including gardens, landscaping, construction sites, waste lots, and roadsides, can be productive places to botanize. If you do find an unusual weed, consider documenting it by collecting a herbarium specimen, as I did for the *Urtica*, to provide a permanent, verifiable, and publicly accessible record of its presence. The Rocky Mountain Herbarium can assist with identifications and will accept properly prepared specimens.



Right: Closeup of stinging stem hairs on *Urtica urens*, photo by Ben Legler

Botanists' Bookshelf:

Sagebrush biome conservation in the western United States

Review by Bonnie Heidel

Remington, T.E., P.A. Deibert, S.E. Hanser, D.M. Davis, L.A. Robb and J.L. Welty. 2021. Sagebrush Conservation Strategy – Part 1. Challenges to Sagebrush Conservation. U.S. Geological Survey; Open-File Report 2020-1125. 327 pp. https://pubs.usgs.gov/of/2020/1125/ofr20201125.pdf. ISSN 0196-1497 (print); ISSN 2331-1258 (online).

A U.S.G.S. publication of phenomenal breadth quietly launched last spring – a magnum opus on sagebrush ecosystem conservation in the western United States, including: the importance of the sagebrush ecosystem to wildlife and people, the agents of change to this ecosystem, and models for its management. It became an instant go-to reference for natural resource professionals, students, and the general public across the 12-state area of the sagebrush biome (Figure 1).

I looked forward to reading a publication that aimed to "…provide guidance so that the unparalleled collaborative efforts to conserve the iconic greater sage-grouse (*Centrocercus urophasianus*) … can be expanded to the entire sagebrush biome to benefit the people and wildlife that depend on this ecosystem." No less than 94 collaborators made this possible, including the big names in natural resources management. Much has already been written about greater sage-grouse as central figure in the sagebrush biome, including its habitat requirements and population biology. This publication treats much of the rest of the vertebrate fauna, and an overview of conservation and management challenges.

Taxonomic changes among the woody sagebrush (*Artemisia* subgenus *Tridentae*) were duly noted. The overview of sagebrush ecology had no more detail than to list the 18 dominant sagebrush taxa in the region, falling into one of two plant communities (sagebrush shrubland or steppe). The opening paragraph of the section stated that there are fundamental differences of structure, composition, productivity and distribution within the sagebrush biome but ensuing text gave little further information. Of the plant taxa mentioned by name in the entire publication, almost half were non-native species (41 of 89 taxa) or trees at the interface with sagebrush (12 species), leaving the roster of sagebrush dominants, a smattering of desert scrub species that intermix, two native grasses and not much else.

Later sections had higher botany or ecology content, including sections on altered fire regimes, invasive plant species and conifer encroachment; and the section on restoration as a current conservation need.

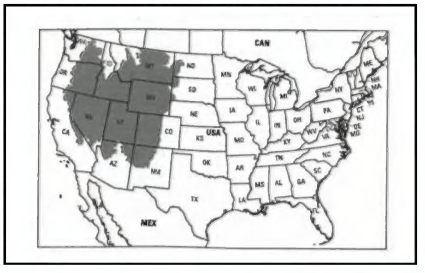


Figure 1. Sagebrush biome in the western U.S., in Remington et al. 2021.

There is a second part of this publication pending, and Part II will summarize conservation needs at ecoregional scales and provide an analysis of barriers and nonregulatory strategies developed though a stakeholder engagement process to overcome these challenges. Yet, without more botanical and ecological information about the biome itself, the breadth of a treatise on the conservation, management and appreciation of our sagebrush biome is constrained.

Clues to Columbine Evolution, continued from p. 1

Additional information on columbine floral morphology and pollination biology will help us understand the fine mechanisms that led to the evolution of the different floral forms and colors in the genus. A team of scientists from the University of Vienna, Austria seeking clues to columbine evolution, came to Wyoming to conduct a small study in the Medicine Bow-Routt National Forest in 2019. We studied *Aquilegia laramiensis* from June 17th to June 22th, as part of a three months' field trip aiming at studying the pollination ecology of several North American columbine species.

We conducted our study at the Friend Park Campground, with the help of information from Wyoming botanists and from researchers of the University of Santa Barbara working on *Aquilegia*. The site can be reached, if the weather allows it, after some hours of driving through the hills of the northern Laramie Mountains. The population is growing in the crevices of imposing reddish granite rocks. Luckily, they were flowering when we arrived, and the small white flowers, sometimes even facing and pressed against the rock's surface, did not seem to beckon pollinators. Our observation periods showed no sign of pollinators so we placed video cameras and recorded over 50 hours of video. Recordings revealed five visits from a bumblebee that we believe could be *Bombus centralis* and 14 visits from bee in the genus *Osmia*, both diving head first in the flowers' spurs to drink nectar, as well as 9 visits from small sweat bees (Halictidae) collecting pollen. Bees can find flowers if they see them, and also if they smell them. We hope to get more information on the navigation cues involved. Our results show that even if scarce, pollinators are there in the field and they do their job.

We returned to Europe long ago, but the story doesn't end here. In a greenhouse study at the Botanical Gardens of Vienna, we placed small mesh bags on some flowers to prevent any insect visit and see whether the species actually needs insect pollination to reproduce. Almost all bagged flowers developed fruits and seeds, meaning that the species most likely can self-pollinate in the absence of pollinators. The process is even facilitated by the movement of the stamens that, once they are ripe and releasing pollen, unfold so that they touch the female part of the flower, ensuring that self-pollen is deposited right on the stigmas. This is a clue that individuals can do the same in the wild, which would be good news for the precious white-flowered Laramie columbine. Even if pollinators are scant, *Aquilegia laramiensis* would still be able to reproduce and colonize, even if slowly, at new cracks and crevices of the beautiful boulder rocks of the Laramie Mountains.

Acknowledgments

The author thanks Bonnie Heidel for helpful comments, Michael Münch for the Laramie columbine picture, and Joseph Wilson and Olivia Messinger Carril for insect identifications.

Selected literature on the topic

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Growing Native Plants

Part 41. More Forbs for Dryer Sites

By Robert Dorn

Dieteria canescens (Machaeranthera canescens), Hoary Spinyaster, is a biennial or short lived perennial to 1.5 feet tall and nearly as wide. The leaves are narrow and to 4 inches long. The flower heads are to 1 inch across and scattered on the upper half of the plant. The ray flowers are blue-purple and the disk flowers are yellow. They appear from July to September. The plants occur naturally in dry, open places in the plains, basins, valleys, and mountains. They prefer full sun and dry, well drained, loose soils. They tolerate some alkalinity and drought. It is easy to grow from fresh seed which is commercially available.

Dieteria canescens, Goshen County

Ivesia gordonii, Gordon Ivesia, is a perennial to 1 foot tall with sprawling to erect stems to 16 inches long. The leaves are narrow and dissected and to 9 inches long. The tiny flowers are yellow and clustered in a rounded head to 1 inch across at the tips of stems and branches. They appear from June to August depending on elevation. The plants occur naturally in dry, barren places of the plains, basins, and mountains. They prefer full sun and dry, loamy, well drained soil but tolerate clay soils. It can be grown from seed surface sown for light exposure and kept moist. Seed is commercially available.

Ivesia gordonii, Uinta County

Oenothera howardii, Howard Evening primrose, is a perennial to 6 inches tall and 1 foot wide. The leaves are mostly in a basal rosette, to 9 inches long and 1.25 inches wide. The flowers are yellow but fade to orange, bronze, or nearly red, to 6 inches across, borne singly from the basal rosette with many flowers per plant. They appear from May to July. The plants occur naturally in dry, open places of the plains and basins, often on white, chalky clay. They prefer full sun and dry, well drained to clayey soils with high limestone content. It can be grown from fresh seed sown where it is desired to grow. Cold stratification for 60 days may help germination. They are difficult to transplant. Seed is commercially available.

Oenothera howardii, Laramie County

Rumex venosus, Veiny Dock, is a rhizomatous perennial to 1.5 feet tall and wide. It can be aggressive forming large patches. The leaves are to 5 inches long and 2.5 inches wide. The flowers are at first inconspicuous and greenish clustered at the stem tips. They appear from April to June. Some of the perianth segments later greatly enlarge to 1 inch long and are red to pink. The plants occur naturally in sandy or gravelly places in the plains, valleys, and basins. They prefer full sun and dry, well drained, sandy soils. It can be grown from seed or rootstock cuttings.

Rumex venosus, Goshen County

Townsendia hookeri, Hooker Daisy, is a perennial to 2 inches tall. The leaves are all basal and narrow. The flower heads are sessile among the leaves with white ray flowers and yellow disk flowers. They appear from April to June (rarely as early as February in warm winters). The plants occur naturally on dry, rocky, barren areas in the plains, basins, valleys, and foothills. They prefer full sun and dry, well drained soils. It is easily grown from fresh seed covered lightly with soil.

Townsendia hookeri, Larimer Co., Colorado

To see the above plants in color, go to the newsletter on the Society website.

We Need You – WYNPS Volunteer Opportunities

The Wyoming Native Plant Society Board is looking for members who may have skills and interest to help us out with a couple projects. If either of these roles below interests you, please reach out to WYNPS President Emma Freeland at emma.eileen.freeland@gmail.com for more details. Please note that we strive to keep our membership rates low and accessible (anyone can join for $10), so we are looking first for members willing to take on these projects in a volunteer capacity. For the web development project, we will consider hiring a web developer if we don't find a volunteer.

Web Developer for Website Redesign – Our 10-year-old Word Press website could use a re-design. If you have web design skills and/or Word Press skills and have the time and energy to devote to revamping the website, including implementing an appropriate backups and Word Press updates, please get in touch, we'd love to hear from you.

Facebook Page Manager – We are looking for someone to run the Facebook page! Our ideal volunteer would be enthusiastic and dedicated to providing high quality, accurate botanical information and maintaining a positive Facebook presence. Similar to the newsletter editor, we envision the Facebook Page Manager listening in on monthly Zoom meetings with the WYNPS Board, in order to be able to clearly communicate to the Facebook members the business of the Society.

Linking Up

How many times has your computer frozen going between different online resources for the same species? A couple state and national botany resources launched new links in wonderful new ways to avert such calamity.

First, the PLANTS database (https://plants.sc.egov.usda.gov/home), a USDA Natural Resources Conservation Service tool, now provides species-level links under the "Related Links" tab, to published *Flora of North America* (http://floranorthamerica.org/Main_Page) entries as well as to NatureServe entries (https://www.natureserve.org/access-data).

The Wyoming Field Guide, a Wyoming Natural Diversity Database tool, now includes species-level links to the PLANTS database and to the Rocky Mountain Herbarium (RM) online specimen database search tool (https://www.rockymountainherbarium.org/) at "External Links" buttons. It also links to NatureServe and to field guide entries in select adjoining states. It follows the nomenclature used in the RM checklist (Nelson 2018) cross-referenced and searchable by the nomenclature in Dorn (2001).

WYOMING NATIVE PLANT SOCIETY MEMBERSHIP FORM

Date _____

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Please check all appropriate boxes:

[ ] New member
[ ] Renewing member
[ ] Check here if this an address change
[ ] Annual membership with email notification of newsletters: $10
[ ] Annual membership with mailed newsletters: $12
[ ] Annual membership with scholarship support and email notification of newsletters: $20
[ ] Annual membership with scholarship support and mailed newsletters: $22
[ ] Life membership with email notification of newsletters: $300
[ ] Life membership with mailed newsletters: $300

In addition to the statewide organization, we have two chapters. Membership in chapters is optional; chapter members must also be members of the statewide organization.

[ ] Teton Plants Chapter annual membership: $5
[ ] Sublette Chapter annual membership: $5
[ ] Additional donation of $_____

Total enclosed: _____

Please write checks to **Wyoming Native Plant Society**

Wyoming Native Plant Society
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